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CULTURAL LIFE HISTORIES OF MELANCONIS AND PSEUDOVALSA[1]

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(WITH PLATES 30–33)

The cultural study of the four species here considered presents further evidence for the existence of correlated characters in the perfect and imperfect stages of these fungi, and supports certain conclusions already drawn by the writer (**18, 19**) in regard to these generic groups, as pointed out below.

The genus *Melanconis*, as described by the Tulasnes (**17**, 115), includes both of the genera *Melanconis* and *Pseudovalsa*. The genus *Pseudovalsa* was erected by Cesati and De-Notaris (**2**, 206) on the basis of its ascospores which are three- to many-celled instead of two-celled as in *Melanconis*. There are certain other characters correlated with this difference in the septation of the ascospores.

Although the genus *Melanconis*, as it now stands, contains certain species which obviously have relationships elsewhere, nevertheless, as a generic group it can be quite distinctly recognized. The species of this group have two-celled, hyaline or brown ascospores which are uniseriate or biseriate within a clavate to cylindrical ascus, a well developed ectostroma, practically no entostroma and no blackened zones within the substratum, and a *Melanconium* stage in their life history, often accompanied by a second type of hyaline cylindrical conidium.

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Saccardo (**16**, 740) erected the genus *Melanconiella* for the brown spored species of *Melanconis*. Winter does not recognize this separation, and Ellis merely uses it as a subdivision of the genus. There are certain other characters associated with this difference in spore color, but there are intermediate forms linking the two groups into a continuous series and making any generic separation unfeasible. The hyaline spored species tend to have their spores biseriate in clavate asci; have light colored ectostromata; usually have colored conidia of a lighter tint; and usually have a second type of hyaline cylindrical conidium mixed in with the colored conidia. The brown spored species tend to have their spores arranged uniseriately in a cylindrical ascus; have yellowish- to olive-green ectostromata; have dark colored conidia; and normally do not show the second type of conidium.

The genus *Pseudovalsa*, as it now exists, contains species showing a wider variation and less homogeneity than the genus *Melanconis*. Here too, however, there is a group, including the type species *Pseudovalsa lanciformis* (Fries) De-Not., which shows closely correlated characters. These species have a very strongly developed, dark colored ectostroma, beneath which there is usually a rich development of dark colored entostromatic mycelium within an area of bark tissue at first delimited by a blackened marginal zone. These two tissues are almost indistinguishable at maturity. The ascospores of this group are many celled, larger in general than in *Melanconis*, and are 2- to 3-seriate within broad clavate asci. The imperfect stage is of the form genus *Coryneum*, with sometimes a second hyaline cylindrical type of conidium.

Other species of *Pseudovalsa* show close relationships with certain species of the Massariaceae, and probably should be placed in that family. Petrak (**12**, 114) and others have already pointed out that *Pseudovalsa* (Aglaospora) *profusa* (Fries) Wint. belongs with *Massaria inquinans* and related species. The species of *Pseudovalsa* placed by Petrak (**13**, 324) in his genus *Prosthecium* Fres. are very similar in structure to such forms as *Massaria platanoides* Ces., *M. argus* (Berk. & Br.) Fres., etc. The writer hopes to undertake a cultural study of these forms which should reveal many interesting relationships.

MELANCONIS STILBOSTOMA

Melanconis stilbostoma (Fries) Tul. was collected on *Betula alba* L. near Hubbardston, Mass. It is a representative of the group with hyaline ascospores.

The fungus appears on the surface of the twigs as numerous, circular, pustulate swellings, 1–2 mm. in diameter, through the center of which there project the circular or laterally elongated, white to yellowish, ectostromatic discs, which contain the scattered conical to cylindrical, punctate ostioles. The perithecia are spherical or irregular in shape, 400–640 × 320–400 μ, and arranged circinately beneath the ectostroma, in the unaltered bark cortex (PL. 30, F. 1). The asci (PL. 31, F. 4) are clavate and measure 75–120 × 9–14 μ. The ascospores (PL. 31, F. 5) are biseriate in the ascus, often becoming obliquely uniseriate, elliptic-fusoid, 2-celled, hyaline, constricted at the septum, and measure (13) 15–22 × 5–8 μ, depending upon their degree of maturity.

This species is based on the *Sphaeria stilbostoma* of Fries (**7**, 102; **8**, 403). Fries' type material (Scler. Suec. *145*) in the Farlow Herbarium shows ascospores which, although apparently immature, have indications of three septa and often of appendages at the ends; they measure 20–27 × 5.5–7.5 μ. Other exsiccati of *S. stilbostoma* Fries (Desm. Fl. Cr. Fr. *1257*, Fuckel, Fung. Rhen. *590*) show typical specimens of *Melanconis stilbostoma*. Many of the European exsiccati show spores with an outer gelatinous sheath which is enlarged at the ends to produce appendage-like processes. This is due to the adherence of a layer of the periplasm of the ascus to the spore, especially when not mature, and is not a constant character.

Suspensions of ascospores of this species were sprayed onto agar on October 21, 1925. Twenty-four hours later these spores were germinating by means of a single germ tube 2.5–3.5 μ in diameter. The germinating spores measured 20–23 × 7–9 μ.

Single spore cultures on six per cent oat agar produced a very scant superficial mycelial growth, and a number of spherical to cylindrical, white to yellowish, superficial stromata. These stromata on agar all remained sterile.

On November 5, steam sterilized twigs of *Betula alba* L. were inoculated from a single spore culture. Numerous, erumpent, superficial, hemispherical, whitish stromata were formed upon these twigs, but most of these remained sterile. On the upper drier portion of one twig a number of conidial stromata (PL. 31, F. 1) were formed. The conidial stromata were entirely ectostromatic and originated as white cushion-like masses of mycelium upon the surface of the bark. The central portion of this mycelial tissue tends to grow upwards more rapidly than the peripheral regions. The pressure of this continued growth soon ruptures the periderm and exposes the stroma as the erumpent disc of this species. If a conidial hymenium arises before the overarching periderm is ruptured, it is formed over the entire surface of the ectostroma, and there results a dome-shaped basal stroma clothed with a conidial hymenium, the whole opening to the exterior through a pore in the enclosing periderm. If, on the other hand, the central portion of the stroma bursts through the periderm before conidial formation is initiated upon its surface, this exposed portion remains sterile and conidial hymenia are formed only on the flanks of the stroma still protected by the periderm. The conidial cavities thus formed are lined by a definite hymenial layer of cylindrical hyaline conidiophores measuring 27–37 × 1.5–2 μ. These conidiophores abstrict conidia of two types; one of these is elliptical to fusoid, often narrowed towards one end, one-celled, light brown in color, and measures 13–18 × 4–7 μ (PL. 31, F. 3), while the second type is cylindrical, often slightly curved, one-celled, hyaline, and measures 6.5–12 × 2–2.5 μ (PL. 31, F. 2).

The Tulasnes (**17**, 119) report conidia of three types for this species. Their connection of spermatia, which are slightly curved, 13–20 μ long, and born in labyrinthiform loculed spermagonia, is undoubtedly incorrect. This type of fruit body, which they give as *Naemospora crocea* (Pers.) Fries, *Libertella betulina* Maz., etc., is of the type produced by species of the Allantosphaeriaceae and is very doubtful for a species of *Melanconis*. The second conidial fruit body mentioned (*Melanconium bicolor* Nees., *M. betulinum* Schm. & Kunze, *M. elevatum* Corda, etc.) consists of a stroma with open cavities within which are formed

brown ovate conidia measuring 13–16 × 7–10 μ, and hyaline cylindrical "conidiola" half as long. This corresponds very well to the imperfect stage obtained in pure cultures of this *Melanconis*.

Melanconis stilbostoma, *M. Alni* Tul., and *M. marginalis* (Peck) Weh. all have overlapping ascospore measurements and identical stromatic characters. *M. stilbostoma* differs from the other two species in the lack of appendages upon its spores. In a previous discussion of *M. Alni* and *M. marginalis*, the writer (**19**) kept these two species separate chiefly upon the fact that the Tulasnes (**17**, 122) gave *Melanconium sphaeroideum* Link, with brown ovate conidia measuring 10–13 × 6.5–7.5 μ, as the imperfect stage of *M. Alni*, while pure cultures of *M. marginalis* yielded dilute blackish conidia measuring 10–14 × 4–5 μ. In examining a number of exsiccati of *M. stilbostoma*, there was found constantly associated with it a *Melanconium* with brown conidia measuring 10–15 × 5.5–8 μ, and indistinguishable from those of *M. sphaeroideum*. This again points to the uselessness of depending too much upon observational connections, especially when two or three closely related species occur frequently on the same or similar hosts, and makes a cultural study of the European species all the more desirable.

No evidences of perithecial production were found in any of the cultures of this species.

MELANCONIS DECORAENSIS

Material of *Melanconis decoraensis* Ellis was collected on twigs of *Betula alba* L. near Waverly, Mass. This material agreed in all respects with Ellis type material (N. Am. Fungi *1562*). Peck (**11**, 70) described this as *Melanconiella decorahensis* Ellis and gave the disc as "yellow-green" rather than "sordid-gray," as given by Ellis. Ellis (**6**, 528) made this a variety *subviridis* Peck. This is merely the fresh growing condition of the fungus, the disc being greenish pulverulent when fresh and becoming dirty gray with age.

The fungus appears superficially as small slightly pustulate swellings of the periderm with a central, laterally elongated, gray to olive-green disc which is barely erumpent through a

slight rupture in the periderm. This disc is usually entirely ectostromatic but occasionally penetrates slightly into the bark. The perithecia are spherical to ellipsoidal, 460–1100 × 350–800 μ, and are arranged circinately in the unaltered bark tissue beneath the erumpent disc (PL. 30, F. 2). The asci (PL. 31, F. 8) are long cylindrical with a short stipe-like base and a refractive ring in the tip, and measure 95–120 × 9–11 μ. The spores (PL. 31, F. 9) are obliquely uniseriate to uniseriate in the ascus, fusoid-elliptical, brown, 2-celled, constricted at the septum, acute at the ends, and measure 13–17 × 6.5–8 μ.

Ellis (6) remarks that this species differs from *Melanconis spodiaea* Tul. only in the absence of appendages on the spores. Many exsiccati of *M. spodiaea* show no trace of appendages, while others (Rehm, Ascom. *1145*) do show small cap-like hyaline appendages. These appendages are apparently evanescent, as is the case in many other species of this genus. Figures nine and ten (PLATE 31) are camera lucida drawings of these two species. A comparison of these figures will show that the spores of *M. spodiaea* tend to be somewhat longer and narrower (14–18 × 5.5–7.5 μ), less strongly constricted and more blunt at the ends than those of *M. decoraensis*. Here again we find two closely related species, one (*M. spodiaea*) reported only from Europe, while the second (*M. decoraensis*) has so far been found only in America.

Suspensions of the ascospores from *Betula alba* were sprayed onto agar on September 24, 1925. The following day a few spores were found germinating and additional spores germinated on succeeding days. The germinating spores did not swell, measured 16–18 × 7–9 μ, and produced 1–3 successive germ tubes 3–4 μ in diameter.

Single spore cultures on oat agar produced a superficial mat of white mycelium. Within this mass of hyphae spherical to pulvinate blackened masses appeared. These were more compacted areas of stromatic tissue within which conidia were cut off indiscriminately from the hyphae. The hyphae were finally almost entirely used up in the formation of conidia, and a black mass of spores remained. These conidia (PL. 31, F. 7) were elliptical to ovoid, often with a terminal papilla or scar where

attached to the hypha, dark brown in color, and measured 13–20 × 5–8 μ. In old cultures these conidia became much contorted and presented irregularly bulging outlines.

On November 5, steam sterilized twigs of *Betula alba* L. were inoculated from single spore cultures. On the moist portions of these twigs there were produced erumpent-superficial, grayish to olive-green stromata, which usually remained sterile. On the drier portions of the twigs normal conidial stromata were produced. These fruit bodies arose as mycelial mats upon the surface of the bark. As this tissue increased in amount the older portions took on the typical yellowish-green coloration. Conidial production took place by the swelling of the tips of the marginal, hyaline, actively growing hyphae of this ectostroma. After the laying down of a wall behind this swollen tip, the wall of the spore was thickened and then given a brown coloration. The cross wall cutting the spore off from the hypha is often laid down some distance behind the swollen portion, producing a basal papilla. If conidial production takes place early in the growth of the ectostroma, a hymenial layer of cylindrical conidiophores, measuring 18–27 × 3, 5 μ, are produced over the entire, somewhat dome-shaped surface. The central portion of the ectostroma usually grows more rapidly, however, and ruptures the periderm before conidial production takes place. Upon exposure to the air these hyphae take on the yellowish coloration mentioned, and the production of conidia is limited to the lateral flanks of the stroma. In culture there was usually formed, also, a mass of stromatic tissue between the bark and wood, a condition rather unusual in this genus. The lower actively growing margin of this tissue also produced a hymenial layer resulting in a sort of inverted conidial cavity within the tissue (PL. 31, F. 6).

Ellis (**5**, 75) gives a *Melanconium* with "pip-shaped," olive-black conidia, the same size as the ascospores, as accompanying this species. Such an associated *Melanconium* with blue-black conidial masses also occurred on the writer's material. These conidia were somewhat larger than those obtained in culture, measuring 19–22 × 9–10 μ.

PSEUDOVALSA LONGIPES

A limited number of pustules of *Pseudovalsa longipes* (Tul.) Sacc. were found on twigs of *Quercus coccinea* Muench. sent to the writer by H. M. Kerber from Scranton, Pa. This material agrees in every respect with Ellis, N. Am. Fungi *2758* (in Farlow Herb.) of *Pseudovalsa sigmoidea* (Cooke & Ellis) Sacc. Ellis' type material of *P. sigmoidea* (N. Am. Fungi *1566*) shows only immature hyaline spores of this species. All of the European material of *Pseudovalsa longipes* examined by the writer has shown only hyaline spores. This species is described as having brown ascospores, however, and since the immature material of both *P. sigmoidea* and *P. longipes* are identical, these two species are undoubtedly synonymous. Currey's figures (**4**; *pl. 47, f. 90 and pl. 48, f. 167*) of *Sphaeria arcuata* and *Sphaeria quercina*, which the Tulasnes (**17**, 139) give as synonyms of their *Melanconis longipes*, are also typical of the material here considered.

The fungus appears on the surface of the twigs at first as small conical pustules, caused by the formation of the small ectostromatic disc beneath the periderm. The periderm is ruptured irregularly and the blackened disc with the small papillate ostioles is exposed but scarcely erumpent. The small spherical perithecia, 320–450 μ in diameter, are formed within an area of bark cortex outlined by a blackened zone of tissue. There is a rapid development of dark colored entostromatic mycelium within this area, so that at maturity the perithecia seem to be imbedded in an immersed stroma (PL. 31, F. 11). The asci (PL. 32, F. 4) are stout- to elongate-clavate, and measure 100–150 $\times$ 13–25 μ. The spores (PL. 32, F. 3) are 2- to 3-seriate in the ascus, long cylindrical, straight or somewhat curved, acute at the ends at first, finally blunt, hyaline at first becoming brown at maturity, 4- to 8-septate, constricted at the septa, and measure 45–75 $\times$ 5.5–11 μ. The spores of this species remain hyaline for some time, becoming brown only when fully mature.

Sprays of an ascospore suspension of this species were made on November 22, 1922. Forty-eight hours later some of the spores were found germinating by means of germ tubes from one or both of the end cells, or occasionally from one of the central cells.

Single spore cultures on oatmeal agar produced at first a yellowish-brown discoloration of the agar, and a very slight growth of mycelium which later took on a gray-green tint and finally formed a blackened zone on the surface of the agar. In from two to three weeks, large, hemispherical, grayish- to yellowish-green stromata, 3–5 mm. in diameter, were produced. These stromata exuded greenish-black droplets, and later produced conidia over their entire surface. The first growth of these stromata consisted of fine yellowish interwoven hyphae, 1–2 μ in diameter. The tips of these hyphae were hyaline and more or less parallel, forming a hymenium from which were produced numerous filiform, hamate or curved, hyaline, one-celled conidia measuring 8–15 $\times$ 1–1.5 μ (PL. 32, F. 8). In the later growth of the stroma the hyphae became much enlarged and their walls were thickened and browned. These hyphae were 4–12 μ in diameter, and from their apices were formed a second type of conidium (PL. 32, F. 6) of the form genus *Coryneum*. These conidia varied in shape from cylindric-clavate to irregular-fusoid; they were straight or variously curved or bent, yellow-brown in color, 3- to 8-septate, and measured 47–104 $\times$ 10–14 μ. They were normally found only on the surface of the stroma, but occasionally were found imbedded somewhat beneath the surface.

On December 6, 1922, steam sterilized twigs of *Tilia americana* L. and *Quercus rubra* L. were inoculated from a single spore culture. All of these twigs developed erumpent-superficial stromatic cushions like those formed on agar. The conidial stage on twigs was entirely ectostromatic and originated on the surface of the bark as a mycelial cushion which finally ruptured the periderm. The *Tilia* twig cultures, when examined on Feb. 7, 1923, showed the *Coryneum* stage of the fungus. These stromata (PL. 32, F. 1) were composed of a dense mass of upright parallel, brown, septate hyphae, which abstricted the conidia (PL. 32, F. 5) from their apex. These conidia measured 28–90 $\times$ 8–13 μ, and formed black irregular masses upon the surface. Later cultures on twigs of *Tilia* coated with paraffin gave the second type of stroma bearing the hyaline filiform conidia.

The cultures on oak twigs gave chiefly this second type of stroma (PL. 32, F. 2) which was more compact and made up of

yellowish hyphae 1–2 μ in diameter. The apical portions of these hyphae were arranged parallel to one another, were hyaline, and cut off hyaline, filiform conidia measuring 10–20 $\times$ 1 μ from their tips (PL. 32, F. 7). No indications of the formation of perithecial stromata were found in any of these cultures.

Coryneum Kunzei Corda is given by the Tulasnes (**17**, 139) as the imperfect stage of *Pseudovalsa longipes*. They give the conidia as 4- to 6-celled and 50–60 $\times$ 13–16 μ. Ellis, N. Am. Fungi *632* of *C. Kunzei* shows spores 40–90 $\times$ 9–15 μ. A *Coryneum* stage found associated with *P. longipes* on Krieger, Fung. Sax. *79* showed 5- to 8-celled conidia measuring 45–55 $\times$ 13 μ. The conidia of this *Coryneum* are undoubtedly quite variable in size and shape as was seen to be the case in culture. The Tulasnes suggest the possible existence of a second type of conidium when they state that if "spermatia" or "microconidia" do exist they have not been noticed by them. The cultures of this species show that such a second type of conidium does exist here as in other species of *Melanconis* and *Pseudovalsa*.

PSEUDOVALSA LANCIFORMIS

Material of *Pseudovalsa lanciformis* (Fries) Ces. & De-Not., agreeing with descriptions and all of the exsiccati examined, was collected on *Betula alba* L. near Quincy, Ill.

The stromata of this species vary greatly in size. The pustules formed on the surface are small, circular, conical and 1–1.5 mm. in diameter, or larger, laterally elongated and 2–5 $\times$ 1–2 mm. The stroma is more or less widely erumpent as a circular or fusoid blackened disc containing, when well developed, the short stout cylindric ostioles. The perithecia are spherical to ellipsoidal, 320–500 $\times$ 250–420 μ, and are irregularly arranged within a strongly developed stroma of grayish to black fungous tissue which rests upon the first layer of stone cells beneath the bark surface (PL. 30, F. 3). The asci (PL. 33, F. 3) are clavate to cylindric-clavate, and measure 109–145 $\times$ 18–22 μ. The paraphyses are filiform, band-like. The spores (PL. 33, F. 2) are biseriate in the ascus, elliptic-fusoid, light brown, 5–7- (usually 6-) celled, and measure 30–45 $\times$ 10–15 μ. The ends of the spores are blunt and often capped by a small hyaline area.

Although the writer has not seen Peck's original material, his *Melanconis elliptica* is undoubtedly a synonym of this species. In his original description (**9**, 102) he states that *M. elliptica* differs from *M. lanciformis* in its smaller ascospores (27–34 × 12.5 μ). In a later note (**10**, 87), he, for some reason, transfers this species to the genus *Diatrype*, and states that the spores often reach a length of 45 μ.

Pseudovalsa umbonata (Tul.) Sacc. is this same species on *Quercus*. The Tulasnes (**17**, 138) give no spore measurements for this species, but their description and plate show its similarity to *P. lanciformis*. Winter's spore measurements for *P. umbonata* are those of *P. lanciformis*. The only two exsiccati of *P. umbonata* showing mature spores (Tranz. & Ser. Myc. Ross. *28* & Rehm, Ascom. *227*), seen by the writer, were identical with the specimens of *P. lanciformis* examined. The stromata on oak tend to be circular and not as large as those sometimes found on birch.

A suspension of ascospores from birch twigs was sprayed onto agar on September 27, 1925. Twenty-four hours later a number of spores were found germinating, usually by means of a germ tube from each of the terminal cells. These germ tubes, which also occasionally arose from one of the central cells, were 3–4 μ in diameter. This germination from the terminal cells is not a chance happening, but due to the structure of the ascospore. A small circular area of the apex of the ascospore wall is modified so as to form an easily dissolved germ pore (PL. 33, F. 6). No differential staining reaction was found for this area, but it usually appears as an indefinite hyaline cap. If the spores be placed in a solution of eosin, the protoplasts absorb the stain slowly due to the difficulty of penetration of the brown walls. The end cells become stained long before the central ones due to the easy penetration of the end wall. Each of the protoplasts within the several cells of the ascospore possesses an elastic, outer, plasma membrane, and may expand or contract under varying osmotic conditions. The protoplasts of the terminal cells are lodged in contact with the thin apical germ pore wall. Upon germination these terminal protoplasts take up water and push out a germ tube through the softened end wall (PL. 33,

F. 5). The hyaline plasma membrane can be distinguished as being continuous about the periphery of this germ tube. When the spores are treated with rather concentrated sulphuric acid, the terminal germ pore gelatinizes and dissolves, and the terminal protoplasts are forced out through the opening thus formed (PL. 33, F. 7). If this action be more violent, the protoplasts of successive cells, along with a gelatinous material which surrounds them within the spore, are pushed out through this opening (PL. 33, F. 8).

Single spore cultures on oat agar produced numerous, pulvinate, grayish-green to black, superficial stromata. On January 11, 1926, conidia were found in these cultures. The interior of the stromata were composed of a fused mass of hyaline hyphae, while the outer layers in the majority of cases, which remained sterile, were composed of dark-walled intertwined hyphae. In the case of the fertile stromata the actively growing tips of the exterior hyphae produced brown colored conidia successively from their apices forming a compact black mass of conidia on the surface of the stroma. These conidia (PL. 33, F. 4) were fusoid-elliptical to clavate, tapering towards the ends but truncate at the apex, brown, 4- to 6-celled, and measured 31–45 × 13–15 μ. The conidia formed in culture were more irregular in outline than those found under natural conditions.

On November 5, 1925, steam sterilized twigs of *Betula alba* L. were inoculated from a single spore culture. Numerous erumpent-superficial, irregularly pulvinate to elongate, grayish to black stromata were formed in these cultures. They were entirely ectostromatic, arising on the bark surface and breaking through the periderm. These stromata had a structure similar to that of the stromata formed on agar, and some of them produced the normal *Coryneum* type of fruit body (PL. 33, F. 1). In many cases, however, an unusual condition arose. In these stromata (PL. 33, F. 10) the conidia were formed in what must be considered a pycnidial locule. Ruhland (**15**, 57) in his discussion of the development of this species described what he says is apparently a pycnidial formation. He interpreted this condition as resulting from the formation of conidia upon the apical hyphae of the young stroma before it had ruptured the periderm.

These conidiophores, he says, being too delicate to rupture the thick periderm were crowded together by their own growth while the outer heavy walled area of the stroma grew upward, ruptured the periderm, and more or less enveloped this group of conidiophores, forming a cavity with a small apical opening. To the writer, this interpretation seems improbable, and certainly is not the case with the pycnidial formations in culture. In the first place the outer heavy-walled cell layers of the stroma are composed of empty cells and could not grow up around the conidiophores, as stated by Ruhland; secondly, the pycnidia formed in culture were in the superficial portion of the stroma, and not beneath the periderm; and thirdly, the conidia were formed within the central, hyaline, actively growing tissue of the stroma, and not upon its surface. What actually occurs is as follows. It has already been mentioned that in this species the inner portions of the conidial stromata are composed of actively growing hyaline hyphae. Under normal conditions these hyphae produce the conidia from their apices on the surface of the stroma. It has also been noted that in culture sterile stromata are formed, in which case the terminal portions of the hyphae become thick-walled and browned without the formation of conidia. It is in such stromata, in which the central mass of hyaline hyphae has remained in an actively growing condition, that conidial locules are formed. These central cells in such stromata are filled with protoplasm and take a deep stain with eosin. Certain cells, scattered indiscriminately throughout this tissue, enlarge, become septate, and give rise to typical conidia (PL. 33, F. 9). These scattered conidia remain imbedded within the central hyaline matrix, which is in turn surrounded by the outer wall-like layers of dark colored thick-walled cells. This formation of conidia scattered throughout a primordial tissue is similar to that described by Archer (1) for *Asterosporium Hoffmanni* Kunze, except that in *Asterosporium* the entire central tissue is used up in the formation of conidia leaving a true pycnidial locule. No perithecial stage is known for this *Asterosporium*, but the writer considers it probable that it is the imperfect stage of one of the Massariaceae, a number of which have a *Hendersonia* stage in their life history. It has already been stated that some species of

Pseudovalsa show relationships with the Massariaceae. In this connection it is interesting to note this apparent transitional formation between a *Coryneum* and a *Hendersonia*-like fruit body. This pycnidial formation of *P. lanciformis*, to be sure, is strongly stromatic and superficial, and does not resemble the sub-epidermal pycnidia of certain species of *Massaria*, but it does show the possible common origin of pycnidial and *Coryneum*-like fruit bodies.

The Tulasnes (**17**, 135) give *Coryneum disciforme* Corda as the imperfect stage of their *Melanconis lanciformis*. This imperfect stage (Fuckel. Fung. Rhen. *2334* and Krieg. Fung. Sax. *436*) shows a stromatic structure and conidia (37–46 × 13–15 μ) identical with the *Coryneum* found in culture. The Tulasnes also mention and figure hyaline, curved, cylindrical "spermatia." No such second type of conidia has so far been found in any of the writer's cultures. The same authors (**17**, 138) give *Coryneum umbonatum* Nees (*Steganosporium elevatum* Riess) as the imperfect stage of *P. umbonata*. The conidia of *C. umbonatum* are identical with those of *C. disciforme* except that the width of the spores, according to various descriptions, is somewhat greater (16–22 μ) for *C. umbonatum*. Saccardo's Myc. Ital. *1568*, of *C. umbonatum* on *Quercus*, does show such somewhat larger spores (46–55 × 18–22 μ). Whether this constitutes a variety on oak, or is merely a variation due to the different substratum, is another question which can be settled only by a comparative cultural study of material from the two hosts. Riess (**14**), in his discussion of *Steganosporium elevatum*, speaks of the fruit body as a "pseudoperithecium," and states that the spores are at first enclosed within a wall-like membrane, which suggests the condition already described from cultures of *P. lanciformis*.

Currey (**3**) connects *Hendersonia polycystis* Berk. & Br. (*Myxocyclus confluens* Riess) with *Sphaeria lanciformis*. This is undoubtedly incorrect, as this *Hendersonia* has muriform conidia enclosed within a gelatinous sheath, and is probably the imperfect stage of one of the Massariaceae.

Ruhland (**15**) considers *Pseudovalsa lanciformis* to belong to his "haplostromatic" type, that is, to be lacking in the possession of any entostroma. No perithecial stromata were formed in

culture, but in nature these stromata are chiefly, and sometimes entirely, ectostromatic, being formed upon the bark surface. The blackened surface zone of this ectostroma often penetrates into the bark as far as the first layer of stone cells, however, and when this is the case the enclosed bark area is thickly intergrown with blackened entostromatic hyphae which form a blackened sclerotial mass scarcely distinguishable from the ectostroma. The perithecia are usually formed within the ectostroma.

SUMMARY

The imperfect stages of two species of *Melanconis* and two species of *Pseudovalsa* were obtained in single ascospore cultures.

Melanconis stilbostoma (Fries) Tul., with hyaline ascospores, produced a *Melanconium* stage agreeing with *M. bicolor* Nees, and containing a second type of hyaline cylindrical conidium intermixed with the brown elliptical conidia.

Melanconis decoraensis Ellis, with brown ascospores, produced a *Melanconium* stage, but no second type of conidium.

Pseudovalsa longipes (Tul.) Sacc. produced a *Coryneum* stage agreeing with *C. Kunzei* Corda, and also a second type of hyaline cylindrical conidium. *P. sigmoidea* (Cooke & Ellis) Sacc. is given as a synonym of *P. longipes*.

Pseudovalsa lanciformis (Fries) Ces. & De-Not. produced a *Coryneum* stage agreeing with *C. disciforme* Corda, but no second type of conidium. Identical conidia were also produced in pycnidial locules enclosed within a stroma. The presence of apical germ pores in the ascospores was noted and described. *Pseudovalsa umbonata* (Tul.) Sacc. is given as a synonym of *P. lanciformis*, with evidences for its being a variety on *Quercus* due to a difference in the size of its conidia (*Coryneum umbonatum* Nees).

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CAMBRIDGE, MASS.

EXPLANATION OF PLATES

PLATE 30

Fig. 1. Vertical section of perithecial stroma of *Melanconis stilbostoma* (Fries) Tul., on *Betula alba* L.

Fig. 2. Vertical section of perithecial stroma of *Melanconis decoraensis* Ellis, on *Betula alba* L.

Fig. 3. Vertical section of perithecial stroma of *Pseudovalsa lanciformis* (Fries) Ces. & De-Not., on *Betula alba* L.

PLATE 31

Melanconis stilbostoma (Fries) Tul.

Fig. 1. Vertical section of conidial fruit body as formed in culture on *Betula alba* L.

Fig. 2. Hyaline cylindrical type of conidium produced in culture.

Fig. 3. Brown *Melanconium* type of conidium produced in culture.

Fig. 4. Ascus with ascospores.

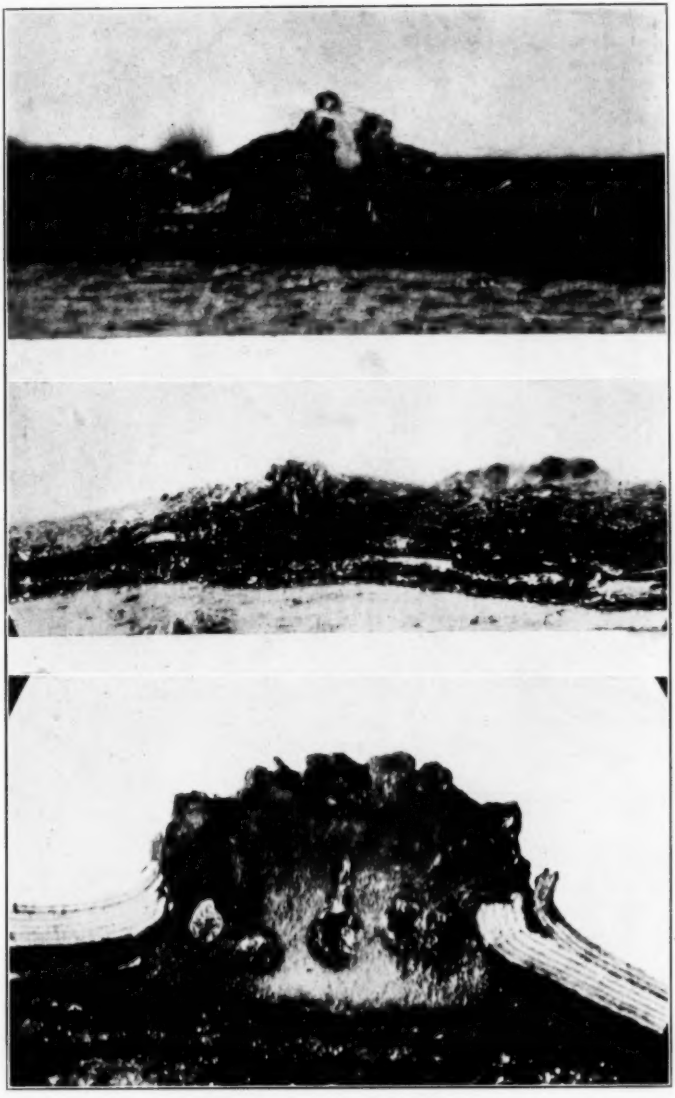
Fig. 5. Ascospores.

Melanconis decoraensis Ellis

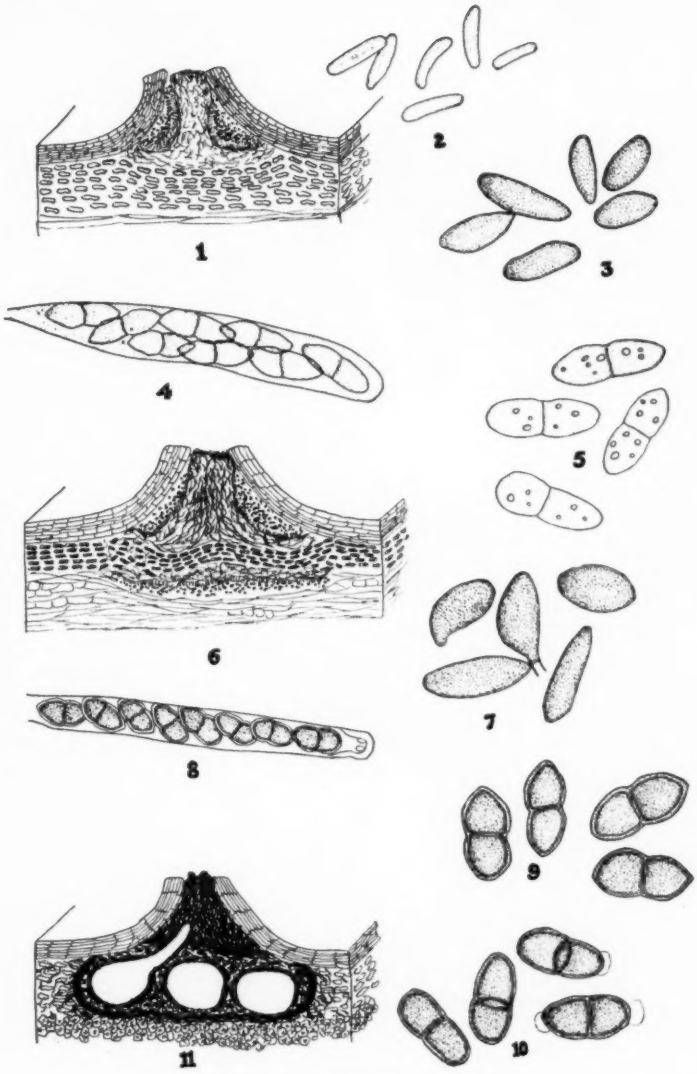
Fig. 6. Vertical section of conidial fruit body as produced on twigs of *Betula*.

Fig. 7. Conidia of *Melanconium* stage produced in culture.

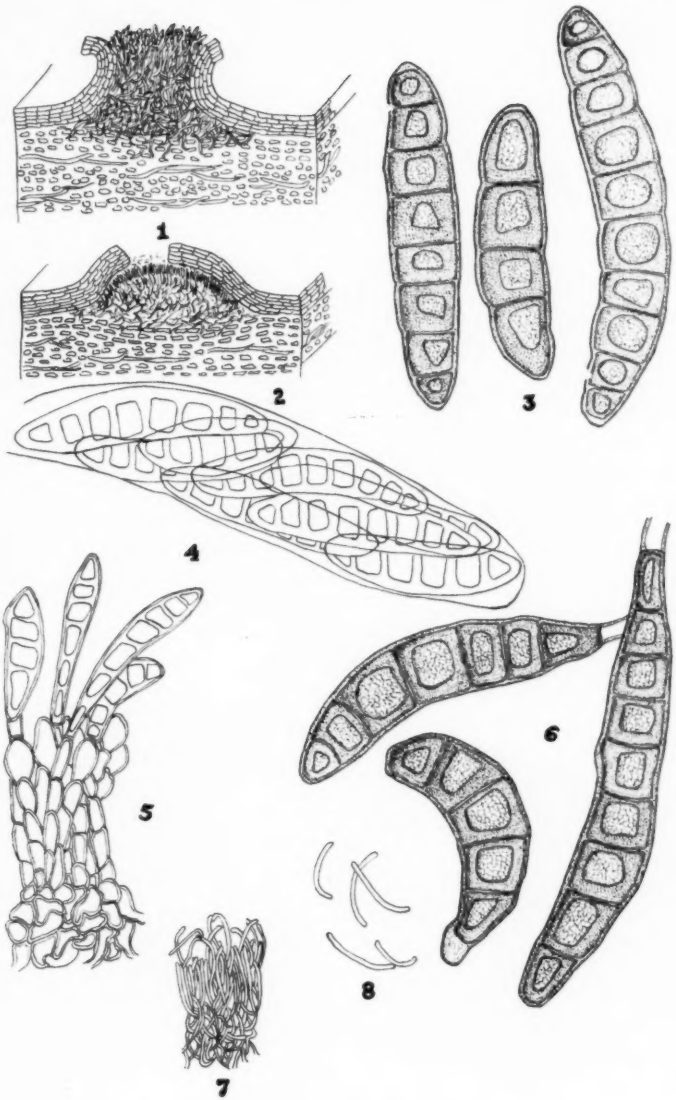
Fig. 8. Ascus with ascospores.



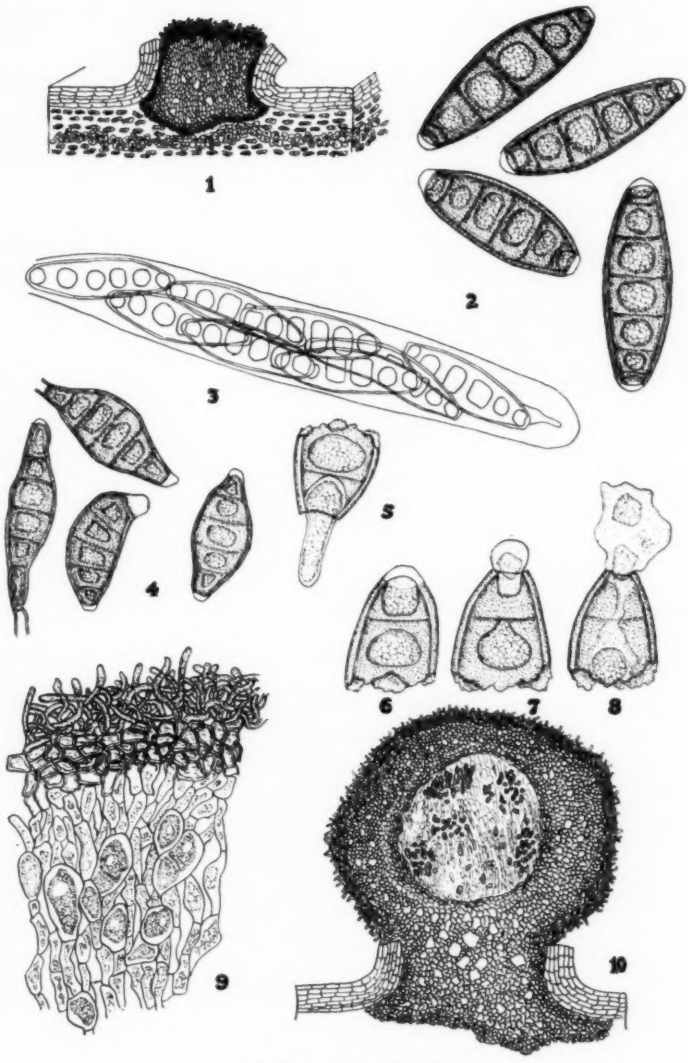
MELANCONIS AND PSEUDOVALSA



MELANCONIS STILBOSTOMA



PSEUDOVALSA LONGIPES



PSEUDOVALSA LANCIFORMIS

Fig. 9. Ascospores.

Fig. 10. Ascospores of *Melanconis spodiaea* Tul. from Rehm, Ascom. *1145*.

Fig. 11. Vertical section of perithecial stroma of *Pseudovalsa longipes* on *Quercus*.

PLATE 32

Pseudovalsa longipes (Tul.) Sacc.

Fig. 1. Vertical section of ectostroma bearing conidia of the *Coryneum* type, as formed on *Tilia* and *Quercus* in culture.

Fig. 2. Vertical section of ectostroma bearing conidia of the hyaline, curved or hamate type, as formed on *Tilia* and *Quercus* in culture.

Fig. 3. Ascospores.

Fig. 4. Ascus with ascospores.

Fig. 5. Portion of hymenial layer of ectostroma producing conidia of the *Coryneum* type.

Fig. 6. Conidia of the *Coryneum* type produced in culture.

Fig. 7. Portion of the hymenial layer of an ectostroma forming hyaline, filiform conidia.

Fig. 8. Hyaline, filiform, hamate conidia produced in culture.

PLATE 33

Pseudovalsa lanciformis (Fries) Ces. & De-Not.

Fig. 1. Vertical section of the *Coryneum* fruiting stage, as formed on *Betula* in culture.

Fig. 2. Ascospores.

Fig. 3. Ascus with ascospores.

Fig. 4. Conidia of the *Coryneum* stage produced in culture.

Fig. 5. Germinating ascospore, showing terminal protoplast growing out through the apical pore of the spore.

Fig. 6. End cells of ascospore, showing structure of the apical modified germ pore.

Fig. 7. Ascospore tip showing solution of apical germ pore, and emergence of terminal protoplast as a result of treatment with concentrated sulphuric acid.

Fig. 8. Ascospore tip, showing similar but more violent action resulting in ejection of several protoplasts and the gelatinous substance surrounding them in the spore.

Fig. 9. Portion of a vertical section of the pycnidial formations found in cultures on *Betula alba*, showing spore initials forming within the central hyaline tissue.

Fig. 10. Vertical section of such a mature pycnidial formation, showing conidia within an enclosed stromatic matrix.

OBSERVATIONS ON CALYPTOSPORA COLUMNARIS AND PERIDERMIUM ORNAMENTALE

JAMES ROBERT WEIR

(WITH PLATES 34 AND 35)

Hartig (**6**) was the first to demonstrate the life cycle of this rust in Europe. He used aecia on *Abies pectinata* and telia on *Vaccinium Vitis-Idaea* and obtained infections in both directions. Kuehn, Bubak and Winter fully verified the results of Hartig. In America the first successful cultures were made by Arthur (**2**) in 1909. He infected *Abies Fraseri* with telia on *Vaccinium pennsylvanicum* sent by Fraser from Nova Scotia. The aecial stage was collected by Fraser (**3**) in 1909 on *Abies balsamea*. This is the first American collection recorded from nature. In 1911 Fraser (**4**) reported successful inoculations on *Abies balsamea* with telial material from *Vaccinium pennsylvanicum*. Fraser (**5**) repeated this experiment in 1913, amply verifying the results of previous investigators.

The writer investigated this rust for several years, but not until 1918 were inoculation experiments successful. On Sept. 14, 1918, on the hills south of the Spokane River, opposite the town of Coeur d'Alene, Idaho, material with cylindrical aecia was collected on *Abies lasiocarpa* in considerable quantity. This material (No. *16210*) was taken across the river to the other side of the town about three miles away and in a pure stand of *Pinus contorta* in a moist ravine, the aeciospores were dusted over young shoots of an isolated clump of *Vaccinium membranaceum*. On Oct. 3, 1919, three shoots of the season were found characteristically deformed and swollen bearing the spongy telial layer (*16213*). When collected and placed in a damp chamber for a few days the teliospores were found in abundance within the epidermal cells. The rust on *Vaccinium* was not found anywhere in the neighborhood other than on the plant inoculated. The

nearest firs were those from which the aeciospores were obtained.

The teliospores resulting from this inoculation were of the type described by Hartig, Arthur, Sydow, and others.

In September 1919 a successful inoculation experiment in the opposite direction was conducted by the writer at Coolin, Idaho. A small tree of *Abies lasiocarpa*, originally from Montana, and about one foot and a half high, was taken from the arboretum at Spokane, Washington, and transplanted alongside of a clump of *Vaccinium membranaceum* on which were several witches' brooms of *Calyptospora columnaris* (*16212*). One of the brooms with vigorous telial shoots of the season, and the crown of the young tree were tied together so that their branches intermingled. The plants were located in a deep ravine in a mixed stand of mature *Pinus monticola*, *Pseudotsuga taxifolia*, and some hard woods. There was very little sunlight at any season. The place was visited Aug. 13, 1920, and aecia with uniform cylindrical peridia were found sparingly on the leaves of the fir (No. *16211*). Since there was no chance for the fir to become infected previously, and its neighbors in the arboretum were free from the rust, it is safe to conclude that this experiment was successful. The microscopical characters of the aecia resulting from this experiment conformed to the established description for the species. Aecia were not found on any other tree in the vicinity.

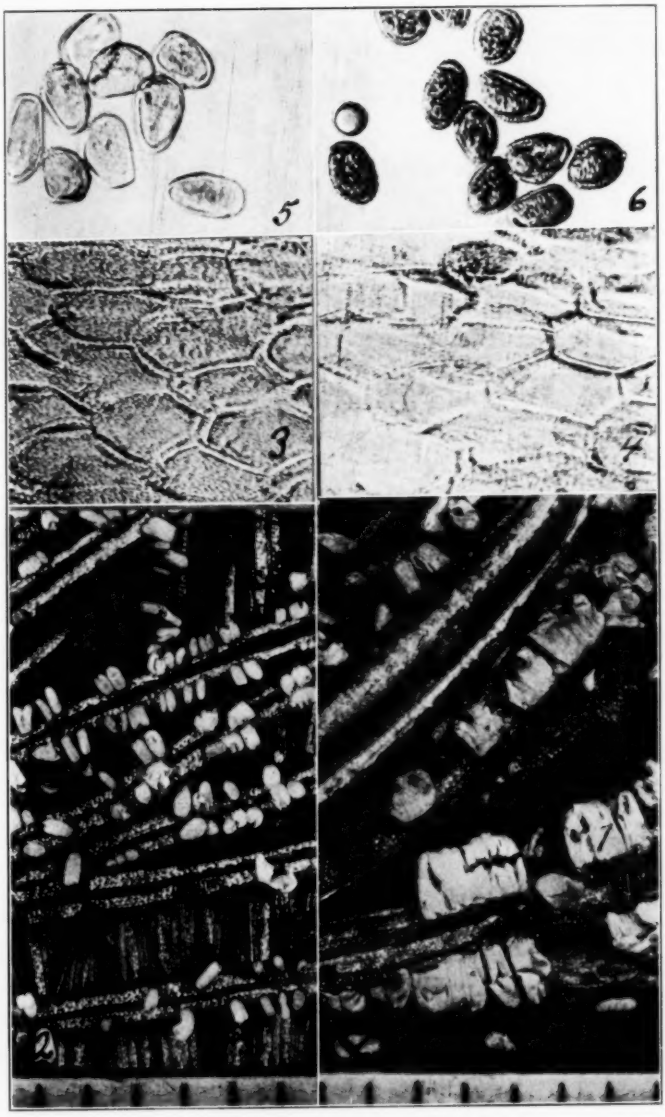
According to Hartig (7) the sporidia may either directly reinfect *Vaccinium* or the leaves of *Abies*, in other words, to employ a term used by Frank, the rust is facultative heteroecious. This assertion is repeated in the Kew Bulletin (1907). Hartig gave no experimental evidence to support his statement other than the fact that the rust on *Vaccinium* occurred in districts from which the aecial host was absent. Direct telial infection of *Vaccinium* by means of sporidia has been attempted in four specific instances by the writer, but always with negative results. It has been possible, however, to infect young shoots of *Vaccinium membranaceum* with immature tissue taken from the upper extremities of telial infections on the same host. This was effected by inserting small pieces of this tissue into incisions in the terminal leaf axils before the teliospore layer is formed. Three such inoculations, well protected with cotton, were made

in the open on May 13, 1919. On May 10, 1920, one of these inoculations had taken effect with the usual malformation of the young shoot of the host. This is comparable to the upward advance of the mycelium in young shoots from the previous year's infection.

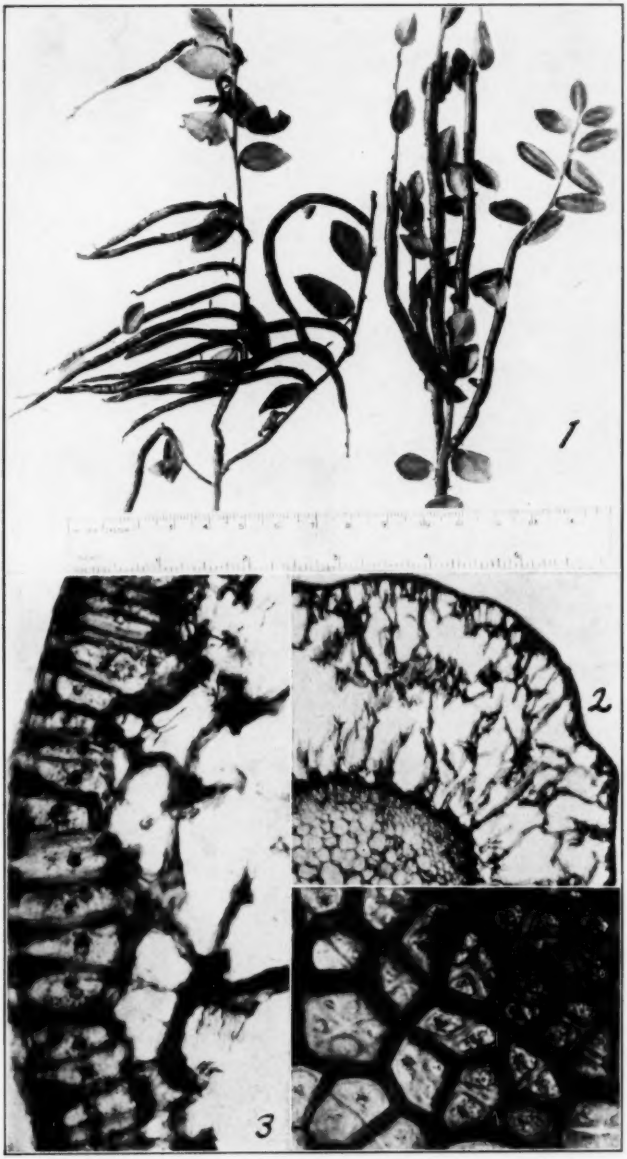
Arthur (**1**) refers to the pycnia of this rust as uncertain, and European authors have not reported this spore form. Pycnia, however, were found in a collection (*1227*) made by the writer at Columbia Falls, Montana, and reported in 1918 (**8**). The pycnia containing oval hyaline spores appear as brownish or black dots on either side of the midrib.

The most outstanding result from these experiments lies in the fact that the aecial form with small, narrow, uniform, cylindrical or columnar peridia (PL. 34, FIGS. 2, 3, 5) produced the typical telial stage on *Vaccinium* (PL. 35, FIGS. 1–3), and also appeared as a result of inoculation from telial material on this host. The aecia obtained by Fraser and Arthur were also of the small cylindrical type. This would imply that the telial material used would in all cases produce the same type of aecia and which is apparently different from the form on *Abies* which produces large cylindrical or flattened peridia described under the name *Peridermium ornamentale* Arth. and which is also associated with the rust on *Vaccinium*. The microscopical characters of the latter (PL. 34, FIGS. 1, 4, 6) are very similar to the aecial stage of *Calyptospora columnaris*, but the gross appearances of the two are very unlike. It is here proposed to reverse an earlier view on the identity of the aecial form on *Abies* with large cylindrical or flattened peridia and suggest the probability of their being another species of *Calyptospora* with telia on *Vaccinium*. This suggestion is based purely on field observations. All collections of the large aecial form so far made by the writer have been in close association with the typically appearing telial stage on *Vaccinium*. Wherever the large aecial form has been collected the form with small cylindrical peridia has been absent, with the reverse as true. Another view would be that the size of the aecia is influenced by the vigor of the host and that the two forms are identical.

Calyptospora columnaris is very destructive to various species



PERIDERMIUM ORNAMENTALE
CALYPTOSPORA COLUMNARIS



CALYPTOSPORA COLUMNARIS

of *Vaccinium* in the Western United States. Since the disease is of considerable importance on mountain cranberry (*Vaccinium Vitis-Idaea* and *V. corymbosum*) in the East, it is hoped that the problem of infection in regions far removed from aecial hosts and the identity of *Peridermium ornamentale* will be explained.

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ILLUSTRATIONS

Photographs by Dr. A. S. Rhoads and the writer unless otherwise indicated

EXPLANATION OF PLATES

PLATE 34

Fig. 1. *Peridermium ornamentale* on *Abies lasiocarpa*, Mt. Adams (Mt. Pado), Washington, Suksdorf, No. *588* (type).
Fig. 2. *Calyptospora columnaris* on *Abies lasiocarpa*, Fox Park, Wyoming.
Fig. 3. Peridial cells of *Calyptospora columnaris*. × 532.
Fig. 4. Peridial cells of type of *Peridermium ornamentale*. × 532.
Fig. 5. Aeciospores of *Calyptospora columnaris*. × 532.
Fig. 6. Aeciospores of type of *Peridermium ornamentale*. × 532.

PLATE 35

Fig. 1. Telial stage of *Calyptospora columnaris* on *Vaccinium ovatum*, Waldo, Oregon. Reduced.
Fig. 2. Cross section through the telial cushion showing nature of tissue and telial zone. × 35.
Fig. 3. Cross and longitudinal sections of teliospores. × 500. Photo. by F. L. Goll.

OCCURRENCE OF THE CURRANT CANE BLIGHT FUNGUS ON NUMEROUS HOSTS IN THE SOUTHERN STATES

NEIL E. STEVENS

(WITH 1 TEXT FIGURE)

Although the disease of cultivated currants (*Ribes* sp.), generally called cane blight, has been known for thirty-five years, and the causal organism was isolated and described in 1911, the occurrence of this fungus (*Botryosphaeria Ribis chromogena* G. & D.) on hosts other than currant was reported only two years ago.[1] Evidence is now in hand to show that *B. Ribis chromogena*, like the saprophytic and non-chromogenic *B. Ribis*,[2] occurs on numerous hosts far south of the limit of cultivation of the currant.

THE DISTRIBUTION OF CURRANT CANE BLIGHT

So far as is now known, currant cane blight is a serious disease only in the regions marked "C" on the accompanying map (FIGURE 1); that is, New Jersey and the Hudson Valley region of New York. Farther south very few currants are grown, though the occasional small patches found usually show the disease. Cane blight is also found to some extent in Massachusetts, Connecticut, northern New York and Ohio, though it has rarely been serious in these regions. Thus far the fungus has not been collected in Canada or Alaska even where currants are commonly grown.

THE ROT OF APPLES CAUSED BY THE CURRANT CANE BLIGHT FUNGUS

While studying certain fungi causing decay of apples, Fenner [3] proved that a rot indistinguishable from true black rot, due to

[1] Stevens, N. E., & Jenkins, A. E., Occurrence of the Currant Cane Blight Fungus on Other Hosts. Jour. Agr. Res. **27**: 837–844. 1924.

[2] Shear, C. L., Stevens, N. E., & Wilcox, M. S., *Botryosphaeria* and *Physalospora* in the Eastern United States. MYCOLOGIA **17**: 98–107. 1925.

[3] Fenner, E. A., A Rot of Apples Caused by *Botryosphaeria Ribis*. Phytopathology **15**: 230–234. 1925.

Physalospora malorum (Peck) Shear, was caused by *B. Ribis* and *B. Ribis chromogena*. The identity of this chromogen with the currant cane blight fungus was established not only by their agreement in morphological and cultural characters but by inoculation experiments. Healthy currant bushes were inoculated with cultures of the apple fungus, as well as cultures of the same fungus from rose (*Rosa setipoda*) and horsechestnut (*Aesculus Hippocastanum*) and typical cane blight produced. The currant cane blight fungus was found in decayed apples from the points indicated by "A" on the accompanying map (FIGURE 1), namely, Arlington Farm and Covesville, Virginia, and Fort Valley, Georgia.

THE CURRANT CANE BLIGHT FUNGUS IN THE SOUTHERN STATES AND CUBA

The discovery of the currant cane blight fungus on rose and horsechestnut, while establishing the fact that the fungus could grow on hosts other than *Ribes* sp., did not extend its known range. Even its occurrence on apples at Fort Valley, Georgia, might have been due to the fungus being brought in on apple or peach stock. Subsequent study has proved, however, that the fungus is well established on numerous native hosts in Georgia and Florida.

During a collecting trip in the winter and spring of 1924 the writer found *B. Ribis chromogena* on *Cassia* sp., *Hicoria Pecan* and *Gossypium hirsutum* in Georgia, and on *Amygdalus Persica*, *Baccharis* sp., *Berberis* sp., *Laguncularia racemosa*, *Liquidambar Styraciflua*, *Liriodendron Tulipifera*, *Magnolia* sp., *Poinciana pulcherrima*, *Quercus* spp. (two specimens), *Ricinus communis*, *Salix* spp. (four specimens), *Sambucus* sp., and several unidentified hosts in Florida. Recently the same fungus was found by G. M. Darrow on cultivated raspberries in Florida. The localities in which these collections were made are approximately indicated on the accompanying map by dots. Reference to the map shows that the fungus was found in various parts of Florida and was collected several times in the extreme southern end of the peninsula. It is then not surprising that it was also found during a brief collecting trip in Cuba in January, 1925, on cut

branches of *Acalypha marginata* growing on the estate of F. S. Earle at Herradura.

In most cases the fungus was found on cut branches of the hosts named but the material from cotton came from an old root and that from pecan was found on a tree which had been killed by lightning.

FIG. 1.—Outline map of the eastern portion of the United States showing localities in which currant cane blight fungus has been collected. "A" indicates places where it has been found causing decay of apples. "C" indicates localities in which currant cane blight is severe. Dots indicate collections on other hosts.

As has been pointed out several times it is as yet impossible to distinguish *B. Ribis* (which is saprophytic on currants) from the

parasitic *B. Ribis chromogena* by morphological characters. Consequently, single ascospore cultures were made from all specimens on which good ascospores were found. Those listed in the foregoing paragraph as the currant cane blight fungus are those which not only agreed with *B. Ribis* in ascospore measurements and in the size of the pycnospores produced in pure culture from single ascospores but also when grown on corn meal paste showed the pink color characteristic of the parasite.

It was impractical and seemed unnecessary to make inoculations on currant with each of the twenty-nine different numbers which were secured in pure culture. Inoculations on healthy currants were, however, made with the material from Cuba, as well as with one culture from Georgia and one from Florida. In each case the typical cane blight was produced. It is thus apparent that the currant cane blight fungus actually occurs on native hosts in the southeastern United States and in Cuba.

GENERAL CONSIDERATIONS

From the facts now available it is evident that in *Botryosphaeria Ribis chromogena* we are dealing with a fungus whose range only partly overlaps that of the host on which it has been longest known and on which it is most destructive. Cane blight is so severe toward the southern limits of cultivation of the currant that it has never yet been successfully controlled in large plantations. A little farther north the disease is apparently severe in certain seasons and much less destructive in others. Then comes a region where the fungus is usually present on dead currant canes but has never been known to cause serious damage. While in northern New England, Canada, and Alaska, even in those regions where the currant is commonly grown, neither the cane blight fungus nor the saprophytic *Botryosphaeria Ribis* has yet been found on any host.

South of the area of cultivation of the currant, on the other hand, even in tropical and sub-tropical regions more than a thousand miles from the region where the currant is grown commercially, the currant fungus is apparently fairly common on a variety of hosts. These facts suggest that the fungus was originally confined to native hosts of southern range and that

the introduced species of currant proved susceptible to its attacks when grown within the region of its natural range. This suggestion seems to be supported by the fact that the fungus has not been found on the currant in Europe.

SUMMARY

The currant cane blight fungus, *Botryosphaeria Ribis chromogena*, has been found on numerous hosts, many of them native species, in Georgia and Florida; and once in Cuba.

The range of the fungus thus extends much farther south than that of the currant. On the other hand, the fungus has not yet been found on any host in the northern portions of the region in which currants are commonly grown.

BUREAU OF PLANT INDUSTRY,
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NOTES AND BRIEF ARTICLES

Professor F. L. Stevens sailed early in June for a three months stay in Europe in the interests of mycology.

Professor C. R. Orton has been granted an extension of leave of absence from Pennsylvania State College, in order to continue his work at Boyce Thompson Institute in research on seed-borne diseases for the Bayer Company, Inc.

Dr. G. H. Godfrey of the Boyce Thompson Institute has resigned his position from the Bayer Company to take a position as pathologist with the Association of Hawaiian Pineapple Canners with headquarters at Honolulu. His entire time will be devoted to research on the pineapple diseases.

Under the title "ADNA," Sammlung *A*us *D*er *Na*tur, Band 4/5 Pilze, Professor Dr. Spilger has recently issued a convenient little handbook of some of the higher fungi including Boletaceae, Polyporaceae, and Hydnaceae. This handbook is of pocket size and consists of 96 pages of text together with 32 beautifully colored plates, each plate illustrating on the average about six species. The text is in German. The book would be exceedingly useful as a field guide. A similar handbook on American species with English descriptions would be still more useful for the American student.

Dr. L. C. Coleman, formerly Mycologist to the Government of Mysore, India, and for the past thirteen years Director of Agriculture in that State, has returned to Canada on leave on account of ill-health. He has been spending the past seven months working in the Department of Botany of the University of Toronto investigating particularly spore-structure in the Polyporaceae.

Dr. L. O. Overholts, of the Pennsylvania State College, accompanied by Mrs. Overholts, and Dr. and Mrs. J. B. Hill spent the early part of the summer in an expedition by auto to the Black Hills, the Yellowstone, and the Colorado Rockies. This is the fourth collecting trip Dr. Overholts has made to the Rockies. They left State College, Pennsylvania, July 1, and returned in time for the Ithaca meeting in August. They made extensive collections of the flowering plants and fungi, and gave some attention to the algae growing in the hot springs of the Yellowstone.

Dr. Howard J. Banker recently returned from a stay of several weeks in Florida where he had been recuperating from a spell of severe illness. Dr. Banker brought with him a number of interesting fungi, among these an unusually large specimen of *Scleroderma Geaster*, a species which was collected commonly by us in Bermuda during the past winter. The fungus occurs submerged in the sand appearing above the surface only after it has ruptured and disseminated its spores. The Florida specimen turned over to the New York Botanical Garden by Dr. Banker was much larger than those collected in Bermuda. Other interesting collection were obtained. F. J. SEAVER.

Word has been received of the death, on July 1, 1926, of Dr. Carlos Spegazzini. After having studied under Beccari and Saccardo in Italy, Dr. Spegazzini turned his attention to the virgin field of the South American flora and in 1880 he published his first contribution to the flora of Argentina in which 140 fungi are listed, most of them new to the Republic. For more than forty-five years he devoted his time to the study of the flora of South America, publishing about 150 papers, not only on fungi but on flowering plants as well. With the death of Dr. Spegazzini mycology loses one of its great leaders and Argentina a true benefactor. RAFAEL A. TORO.

The many friends of the well known mycologist, Curtis G. Lloyd, of Cincinnati, Ohio, will be pleased to know that the Uni-

versity of Cincinnati at the June Commencement Exercises conferred upon Mr. Lloyd the honorary degree of Doctor of Science in recognition of his contributions in the field of mycology. Mr. Lloyd was presented for the degree by Dr. Benedict of the Botany Department of the University.

It is with extreme regret that we learn that Dr. Lloyd has recently been afflicted with failing eyesight to such a degree that it has been necessary for him to abandon his work with fungi at least for the present. H. M. FITZPATRICK.

"CITRUS DISEASES AND THEIR CONTROL"

We have recently received for notice in MYCOLOGIA, under the above title, a book of 582 pages (with many illustrations including a number of colored plates) by Howard S. Fawcett, Professor of Plant Pathology, Graduate School of Tropical Agriculture and Citrus Experiment Station, University of California, and formerly Plant Pathologist, Florida Agricultural Experiment Station. The book also contains sections on Oriental Citrus Diseases by H. Atherton Lee, Plant Pathologist, Experiment Station, Hawaiian Sugar Planters Association and formerly Plant Pathologist, Philippine Bureau of Science.

The introductory chapter is devoted to the history of *Citrus* disease investigation and a discussion of the species of the genus *Citrus*, consideration being given to the structure and physiology of the plants of the genus. In the second chapter, the types of citrous diseases are fully discussed. The term disease is here used in a broad sense to include those caused by animal organisms as well as those due to plant parasites. Physiological diseases are also considered.

After looking over this voluminous work we wonder that anyone would be brave enough to undertake the cultivation of any fruit which is subject to such great variety of maladies. However, as the author has suggested, comparatively few of these diseases are present in any one place and many of them are of minor importance so that after all the cultivation of citrous plants is probably no more hazardous than any other horticultural venture.

The book represents the results of long years of investigation

and study and is doubtless a very complete compilation of the diseases of these plants and the most up-to-date methods of controlling them. F. J. SEAVER.

A NEW SMUT

During the summer of 1925, the writer had the pleasure of directing a class of graduate students in biological research at the Alpine Summer School of Brigham Young University. This summer school is located at Aspen Grove, in the heart of the Wasatch Mountains. Among the many interesting specimens brought in by the enthusiastic and energetic members of the class, there is one—a smut—of more than usual interest. I can find no similar smut recorded in literature, and I here propose it as a new species. I take pleasure in naming it in honor of Mr. Seville Flowers, one of the most indefatigable collectors of the class. The following description has been checked by Mr. George Zundel, to whom thanks are due.

Urocystis Flowersii Garrett, sp. nov. Sori amphigenous in the leaves, broadly elliptical and occasionally confluent; lead-colored, becoming dark brown, 2–5 × .5–1 mm. Spore-balls irregularly oblong to quadrangular, dark brown, very variable in size, 20–42 × 25–75 μ, mostly averaging about 33 × 42 μ. Sterile cells subglobose to elliptical, 5–8 × 13–16 μ, pale yellowish-brown, completely enveloping the spores. Spores 5–7 or occasionally 8 or more, in the ball; 8 × 8 μ.

On *Zygadenus elegans* Pursh. Collected by Seville Flowers, Glacier Cirque, Mt. Timpanogos, above Aspen Grove, Wasatch Mts., Utah Co., Utah, August 8, 1925. Altitude about 11,500 ft.

A. O. GARRETT

GAUMANN'S VERGLEICHENDE MORPHOLOGIE DER PILZE [1]

Over forty years have passed since the classic work of DeBary on this subject appeared and thirty-four years since von Tavel's work on the same subject was published. In the meantime many additions have been made to our knowledge of the fungi. The numerous important papers which have appeared are scattered through the scientific literature of the world and written in many

[1] Gäumann, E., Vergleichende Morphologie der Pilze, 8°, 626 pp., 398 text figs. Gustav Fischer, Jena. Price, bound, 30 marks, unbound, 28 marks.

languages. To summarize and coördinate this great mass of material is a difficult matter. This task has now been undertaken by Doctor Gäumann and accomplished in a very commendable manner.

The term fungi as defined by the author is restricted to chlorophyll-free Thallophytes, excluding the bacteria and Myxomycetes. The lichens, however, are recognized as fungi. The work is divided into two parts. The first part is devoted to general morphology and covers 14 pages. The second part is devoted to the morphology of the different groups. Much attention is naturally given to recent developments in the cytology of the fungi. Arrangement of the groups and the general treatment of the subject is based upon the so-called sexual nuclear phenomena and organs. The author recognizes, however, that our knowledge of this subject is very incomplete and that there is great diversity and difficulty in coördinating the available data. The results of the many recent efforts of mycological investigators to discover and describe the nuclear fusions and reduction divisions in many scattered cases have led some to believe that this line of investigation will provide the best means of determining the derivation and relationships of the various groups.

In the course of the long and diverse evolution of the fungi from their algal ancestors many changes in the form and function of the original reproductive organs have naturally taken place, making it extremely difficult to coördinate the more or less vestigial organs and diverse nuclear phenomena. Much more information and in general of a more dependable character must be obtained before any safe general conclusions can be reached.

The general presentation of the subject given by the author indicates the present state of our knowledge and shows where thorough studies of the nuclear phenomena in reproduction are most needed, and should stimulate more work in this direction.

Attempts to coördinate and evaluate our present knowledge of the life history of the pleomorphic species are also very unsatisfactory and indicate how urgent is the need for more and better work in this direction. Any one seeking a field for biological investigation can scarcely find one in which the possibilities of making important additions to our knowledge are greater than in the morphology and cytology of fungi.

The literature discussed and cited includes the most important papers which have appeared and of course also some of little value. This is inevitable as it is difficult without knowing each author and his training and methods of work to tell whether his statements and conclusions are dependable or not.

The illustrations are numerous and well chosen, and the character of the typographic work is in keeping with the previous good record of the publishers. The work is almost indispensable to every teacher of mycology and advanced student of the fungi. C. L. SHEAR.

A MYCOLOGICAL OMELET

In volume 9 of the American Midland Naturalist (date not given on the reprint) there appeared an article of 265 (interleaved) pages entitled "The Native Flora of the Vicinity of Cold Spring Harbor, L. I., N. Y.," by N. M. Grier. Most of the article is devoted to listing the plants of that locality, from bacteria to flowering plants, inclusive. Mention is made of the article here to illustrate the gross blunders that may easily be made when an outsider gets into a taxonomic field in which his horizon is evidently limited by the small number of species that a college graduate in botany might be expected to know. Without further discussion I cite the following examples from the group of the fungi as listed in this paper.

Page 74. Misspellings readily recognizable in the Ascomycetes are: *Ascophonus* [*Ascophanus*], *Asperpillus* [*Aspergillus*], *Ustilina* [*Ustulina*], and *Sphaerotheca Castagni* [*Castagnei*].

Page 80. Basidiomycetes. In the first family (Agaricaceae) two species and one variety of *Boletinus*, properly referred to the Polyporaceae or the Boletaceae, are listed. Also one finds *Agaricus diminutivus*, and *Psalliota campestris*, both referable either to *Agaricus* or to *Psalliota*, but cogeneric.

Page 82. *Leptoglossum*, an Ascomycete, is listed in the Agaricaceae.

Page 84. *Calocera cornea* and *Dacryomyces chrysocomus* are listed as the two members of the Auriculariaceae, both belonging to the Dacryomycetaceae. *Calastoma cinnabarium* is obviously misspelled [*cinnabarinum*].

Page 86. *Lachnocladium Michenecri* [*Micheneri*] is a slander on Michener. *Stereum versicolor* is not present on Long Island, being a tropical or subtropical species. *Sterigmatocystis* sp. is listed under the Corticiaceae, when it should be referred to the Ascomycetes. There are no species of *Corticium* listed under the Corticiaceae, but *Corticium comedans* is listed under the next family Exobasidiaceae, as is also *Hirneola Auricula-Judae* which should have come under the Auriculariaceae (see p. 84).

Page 90. *Rhytisma acerinum* and *R. Solidaginis* (the latter doubtfully autonomous at best) are listed under the Phallaceae, that includes the "stink horns." We have never noticed an odor to these ascomycetous species that would suggest such a relationship. On the same page the specific part of *Boletus Frostii* is capitalized but *B. Russelli* and *Cyclomyces Greenei* are not.

Page 92. Both *Polyporus cinnabarinus* and *Polystictus cinnabarinus* are listed, while on the next page the same plant (presumably) is referred to as *Trametes cinnabaria* (misspelling for *cinnabarina*).

Page 94. *Simblum rubescens* and *S. sphaerocephalum*, both good Gasteromycetes, are listed among the Polyporaceae. Two (at least) misspellings occur on this page.

Page 96. *Sphaerobolus carpobolus* is written *S. carpololus* and an "i" is omitted from the specific part of *Craterellus cornucopioides*. The family Thelephoraceae contains the genera *Craterellus*, *Hymenochaete*, *Michenera* (misspelled) and *Solenia* (the latter belonging to the Polyporaceae), while *Stereum* is included in the family Corticiaceae on a preceding page. One wonders in what way the family limits have been shifted to permit this.

I have not examined the other plant groups in the list for mistakes. The preceding examples are sufficient warning about straying into unknown pastures. Presumably those lists may be expected to be more correct, especially through Pteridophytes and Spermatophytes, where undoubtedly the author of the paper is much more at home, and to which he should have confined his interests. In this connection, however, the reader is referred to Taylor's critical comment in the December (1925) number of Rhodora, pages 213–215.

An unfortunate thing in connection with the paper is that various botanists of repute are cited as partially responsible for the lists, some in one way and some in another. One can well imagine their chagrin in perusing a list containing such absurdities as given above. The reviewer has always been a stickler for giving credit to whom credit is due in scientific writings, but the foregoing casts doubt on the advisability of this unless opportunity is given to see the manuscript in proof. He is at least well content not to have contributed anything to this list.

Lists, properly made up, are no doubt of very great importance in the taxonomic literature, and their publication should be encouraged. But let us hope that there will be no more of the particular type here discussed. Fortunate it is that the article appeared in a magazine of limited circulation among scientists, so that probably few people will have occasion to read the list critically. The interpagination is doubly fortunate, serving for corrections as well as additions.

L. O. OVERHOLTS.

THE INTERNATIONAL CONGRESS

The International Congress of Plant Sciences held in Ithaca, August 16–23, 1926, was an event of no mean importance in the history of American botany. While mycology was only one of the thirteen sections into which the congress was divided it was in itself an important meeting. The section was presided over by E. J. Butler of the Imperial Bureau of Mycology of Kew, England, with H. M. Fitzpatrick of Cornell University as permanent secretary, assisted by J. H. Miller of the University of Georgia.

Many interesting papers were presented. Classification and the delimitation of species were subjects which provoked a lively discussion and occupied a great deal of the time allowed for debate. The principal conflict seemed to be between the morphological mycologists on the one hand, or those who would classify fungi on morphological characters only, and physiological mycologists on the other, or those who would classify fungi on their behavior or reaction to substratum without regard to morphological characters.

Questions of nomenclature also received considerable attention both in the section of Mycology and also in the section of Taxonomy which the taxonomic mycologists were especially invited to attend on Thursday afternoon. Committees were appointed to submit propositions for consideration at the next congress to be held in London in 1930. FRED J. SEAVER.

IN MEMORY OF GEORGE F. ATKINSON

On August 20, in connection with the meeting of the International Congress of Plant Sciences, at Ithaca, the memory of the late George F. Atkinson was honored by his students and friends at an informal luncheon held in Willard Straight Hall. This was the first time that the students of Atkinson had ever officially gathered together and for some it was the first time that they had ever returned to Ithaca to find him gone. The arrangements were in charge of Dr. J. M. Reade, head of the Department of Botany, University of Georgia. The speakers were Dr. B. M. Duggar, Dr. K. M. Wiegand, Dr. H. S. Jackson, and Dr. H. P. Brown. The following were present: J. C. Arthur, M. F. Barrus, H. P. Brown, W. H. Burkholder, Bradley Moore Davis, W. H. Davis, Gertrude C. Douglas, B. M. Duggar, Caroline Allen Dunham, Arthur J. Eames, C. W. Edgerton, J. H. Faull, Margaret C. Ferguson, H. M. Fitzpatrick, C. Stuart Gager, Margaret A. Graham, Henry Hicks, B. B. Higgins, David F. Hoy, Mitsuharu Ishakawa, H. S. Jackson, Anna E. Jenkins, W. L. Jepson, Robert Matheson, J. C. Needham, Susan P. Nichols, Abigail O'Brien, Alice M. Ottley, H. G. Perry, J. Ramsbottom, J. M. Reade, Donald Reddick, Silence Rowlee, Huron H. Smith, R. E. Stone, J. M. Van Hook, Leva B. Walker, H. H. Whetzel, Maude Cipperly Wiegand, K. M. Wiegand, Anna Allen Wright, A. H. Wright.—H. M. FITZPATRICK.

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